CLAIMS

What is claimed is:

1. Apparatus for coupling a collimated light beam into a wave guide comprising:

   i) a strong focusing lens interposed between the source of said collimated light beam and said waveguide; and

   ii) a weak lens positioned in the path of said collimated light beam either between said source and said strong lens or between said strong lens and said waveguide, said weak lens being translatable along the path of said collimated beam and also having at least one degree of positional freedom in a plane perpendicular to said beam path.

2. Apparatus in accordance with Claim 1 wherein said weak lens has three degrees of positional freedom.

3. Apparatus in accordance with Claim 2 wherein said weak lens has at least one orientational degree of freedom.

4. Apparatus in accordance with Claim 3 wherein said weak lens can be tilted to adjust both its pitch and its yaw.

5. Apparatus in accordance with Claim 1 wherein said weak lens has a focal length in the range of 10mm to 500mm.

6. Apparatus in accordance with Claim 5 wherein said weak lens has a focal length in the range of 20mm to 200mm.

7. Apparatus in accordance with Claim 1 wherein said weak lens has a focal length in the range of from about 10 to about 100 times that of the strong lens.

8. Apparatus in accordance with Claim 7 wherein said weak lens has a focal length in the range of from about 20 to about 50 times that of the strong lens.

9. Apparatus in accordance with Claim 1 wherein said weak lens is a positive lens.

10. Apparatus in accordance with Claim 1 wherein said weak lens is plano convex or biconvex.

11. Apparatus in accordance with Claim 1 wherein said wave guide is a SOA, ridge waveguide, single mode optical fiber or frequency doubling crystal.

12. Apparatus in accordance with Claim 11 wherein said waveguide is a frequency doubling crystal

13. Apparatus in accordance with Claim 1 comprising an external cavity semiconductor laser.

14. Apparatus in accordance with Claim 1 further comprising a strong collimating lens and an optical isolator interposed between said beam source and said focusing lens.

15. Apparatus in accordance with Claim 14 wherein said weak lens has at least one orientational degree of freedom.

16. Apparatus in accordance with Claim 1 wherein said source of collimated light comprises a pump laser and said waveguide comprises a frequency doubling crystal.

17. Apparatus in accordance with Claim 16 wherein said frequency doubling crystal comprises periodically poled Potassium Titanyl Phosphate, Lithium Niobate or Lithium Tantalate

18. Apparatus in accordance with Claim 1 wherein said weak lens is fixedly held in a lens mount contained within a housing, said lens mount being vertically moveable within said housing and said housing being translatable along said beam path and also transverse to said beam path.

19. An external cavity laser comprising: i) a ridge wave guide gain chip, ii) a wavelength selective reflective element which reflects radiation emitted by said gain chip back into said gain chip, iii) a weak lens, and iv) a strong lens which both collimates and focuses said radiation, said strong lens being interposed in said cavity between said gain chip and said weak lens.

20. An external cavity laser in accordance with Claim 19 wherein said wavelength selective reflective element comprises in combination a high reflecting mirror and a tuning filter.

21. A process for achieving maximum coupling efficiency of a collimated optical beam into a waveguide comprising the steps of:

i) interposing a weak lens and a strong lens between the source of said optical beam and said wave guide;

(ii) adjusting the position of said strong lens until the beam power into said wave guide is at or approximately at a maximum value; and

iii) permanently affixing said strong lens and said wave guide to a common rigid support, and iv) adjusting the position of said weak lens along the optical beam axis and along at least one axis perpendicular to said optical beam axis to the extent necessary to recover at least the majority of any coupling efficiency of said optical beam into said waveguide lost as a result of said permanent affixing of said strong lens and said waveguide

22. A process in accordance with Claim 21 wherein said weak lens is adjusted along both of the axes which are perpendicular to the optical beam axis.

23. A process in accordance with Claim 22 wherein at least one of the pitch and yaw of said weak lens is adjusted.

24. A process in accordance with Claim 21 wherein said waveguide comprises a ridge waveguide, frequency doubling crystal, SOA or single mode optical fiber.

25. A process for achieving maximum coupling efficiency of a collimated optical beam into a ridge waveguide gain chip comprising the steps of:

i) interposing a weak lens and a strong lens between said wave guide and a wavelength selective reflective element which reflects radiation emitted by said gain chip back into said gain chip;

ii) adjusting the position of said strong lens until the radiation reflected back into said gain chip is at or approximately at a maximum value;

iii) permanently affixing said strong lens, said reflective element and said wave guide to a common rigid support; and

iv) adjusting the position of said weak lens along the optical beam axis and along at least one axis perpendicular to said optical beam axis to the extent necessary to recover at least the majority of any coupling efficiency of said light beam into said waveguide lost as a result of said permanent affixing of said reflective element, said strong lens and said waveguide.